

Appendix 4 — Criteria

A-4.1 SOLEC 98 Indicator Project Goals, Objectives and Criteria

Project Goals: The aim of the SOLEC 98 indicators project is to gather together a list of indicators that will be used by the Parties (to the GLWQA) to report on the health of the Great Lakes basin ecosystem on a regular basis (ie. yearly, biennially, every five years...). In most cases, these indicators have already been developed by various groups, commissions, or agencies. The goal of this project is to gather the indicators that will be most useful basin-wide and understandable to the interested public (including educators, media, and decision-makers) while remaining scientifically valid.

Project Objectives: To present indicators that represent portions of the Great Lakes ecosystem but show the state of and trends (improving, deteriorating or neutral trends) of a larger ecosystem component so that, used all together, the health of the system can be assessed.

Criteria: The following criteria have been adapted from a recent EPA document, *Process for Selecting Environmental Indicators and Supporting Data*, modified slightly to better fit this project. The three main criteria discussed at length with the SOLEC 98 Steering Committee and the Indicator Group are: 1) are the indicators **necessary** to determine the overall health of the Great Lakes; 2) are the indicators **sufficient** to determine the overall health of the Great Lakes; and 3) are the indicators **feasible** (economically and in terms of human resources) to use in determining the health of the Great Lakes ecosystem? Additional criteria useful for selecting SOLEC indicators are also included.

Criterion	Explanation	Rating*
Validity		
Relevance	Does the indicator present information relevant to Great Lakes ecosystem integrity?	
Appropriate Scale	Does the indicator respond to changes on appropriate geographic (ie. lakewide, basin-wide) and temporal (ie. monthly or yearly) scales for SOLEC reporting?	
Accurate	Does the indicator accurately reflect the ecosystem component it is intended to represent?	
Sensitive	Is the indicator appropriately sensitive, i.e., are changes in the indicator highly correlated with changing trends in the information it is selected to represent?	
Discriminating	Can the indicator distinguish natural variability from human-induced changes?	
Understandability		
Understandable	Is the indicator appropriate for decision-makers and the general public? Is the level of information from the indicator appropriate for environmental managers to use in decision making?	
Simplicity	Is the indicator simple and direct?	

Criterion	Explanation	Rating*
Presentation	Can the indicator be presented in a format tailored to environmental managers?	
Documented	Is the methodology used to create the indicator well-documented and understandable so that it can be easily communicated and reproduced?	
Interpretability		
Interpretable	Is there a reference condition or benchmark for the indicator against which current status and trends can be compared?	
Trend Evaluation	Will data that have been collected over a sufficient period of time allow analysis of trends?	
Information Richness		
Richness	Does the indicator represent multiple ecosystem components or stressors?	
Broad Application	Is the indicator broadly applicable to many geographic areas?	
Data Availability		
Currently existing	Are adequate data available for immediate indicator use?	
Easily Available	Are data easily available? Can they be retrieved with a minimum of fuss?	
Long term record	Do data currently exist to allow for analysis of environmental trends?	
Timeliness		
Timely	Are changes in the environment reflected quickly by the indicator?	
Anticipatory	Does the indicator provide early warning of changes?	
Cost Considerations (Feasibility)		
Ease of Quantification	Does the indicator reflect a feature of the environment that can be quantified simply, using standard methodologies with a known degree of accuracy and precision?	
Data collection	Can data supporting the indicator be obtained with reasonable cost and effort by some Great Lakes organization?	
Calculation and Interpretation	Can calculations and interpretations for the indicator be obtained with reasonable cost and effort?	

* The rating system used during the development of the Indicator List presented at SOLEC 98 (Version 2) was left to the discretion of the Core Groups: some opted to use a simple Yes or No system while a few used a more complex number rating system. See Section A-4.2 for post-SOLEC 98 indicator rating exercise.

Criteria for the whole SOLEC Indicator List:

Are each of these indicators in combination **necessary** to assess the overall health of the Great Lakes ecosystem?

Are these indicators in combination **sufficient** to assess the overall health of the Great Lakes ecosystem?

A-4.2 Post-SOLEC 98 Criteria Rating

After SOLEC 98, the Indicator Group agreed that an independent, third-party assessment of the SOLEC indicators against the 21 criteria (presented in Section A-4.1) would be a useful exercise. It was felt that an evaluation of the degree to which each indicator met the criteria would help validate the proposed indicators that rated high, and would point out those that needed further development work, refinement or even possible removal from the list. The criteria rating could also play a role in prioritizing the indicators for future work. The assessment took place after the majority of revisions had been made to the SOLEC indicators, based on comments and concerns heard at SOLEC 98 and shortly afterwards.

The results presented are preliminary. They represent a summary of the assessment by an independent contractor who is familiar with the description of each indicator, but they have not been endorsed by the SOLEC Indicator Group.

Rating Process

The rating process was based on the 21 criteria from seven different categories presented in the previous section, A-4.1. For SOLEC purposes, some of the categories of criteria can be considered more important than others. For example, at this stage of the indicator development process, it is more important that an indicator is relevant to Great Lakes ecosystem integrity than it is for an indicator to have an existing source of supporting data. To capture the varying importance of the criteria, each of the seven overall criteria categories were assigned a weight based on importance.

Criteria Category	Weight
Validity	3
Understandability	3
Interpretability	3
Information Richness	2
Data Availability	2
Timeliness	1
Cost Considerations (Feasibility)	1

A rather elaborate scheme was invented to provide an overall numeric score for each indicator based on subjective ratings of each of the 21 criteria and the weighting of the 7 criteria groupings. Every indicator was rated on how well it met each of the criteria using a scale of 1 to 3: 1 = does not meet criteria, 2 = partially meets criteria, 3 = fully meets criteria. The assessments were based on the indicator descriptions as written, and in some cases there was insufficient information given to rate a criterion high. Whenever possible, the benefit of the doubt was given to the indicator if the required information could be inferred from the description.

The scores within each category were summed and weighted. The weighted scores were then summed across categories to obtain a total overall score for the indicator. Because this system gave the appearance of much greater precision to the category and the overall scores than was warranted, an index was created by further adjusting the numerical ratings to a 5 point scale and rounding to the nearest whole number. Descriptive rankings were then assigned as follows: 5 = Excellent, 4 = Good, 3 = Moderate, 2 = Fair, 1 = Poor.

Seventy-five of the 80 SOLEC indicators were ranked, and the results are presented in the table that follows. The five indicators from the Societal group were not ranked because they have not been revised since SOLEC 98. Of the 75 ranked indicators, 9 ranked Excellent, 56 ranked Good, and 10 ranked Moderate. Closer inspection by the Core groups of the individual criterion ratings should reveal those aspects of the indicators or the indicator descriptions that could be improved, if possible, to affect a higher rating.

ID #	Indicator Name	Validity	Understandability	Interpretability	Information Richness	Data Availability	Timeliness	Feasibility	Ranking
17	Preyfish Populations	E	E	G	E	E	M	G	Excellent
111	Phosphorus Concentrations and Loadings	G	E	E	E	G	E	E	Excellent
115	Contaminants in Colonial Nesting Waterbirds	E	E	E	E	E	M	E	Excellent
4081	Coliform Levels of Nearshore Recreational Waters	E	E	E	E	M	M	E	Excellent
4176	Air Quality	E	E	E	E	E	G	E	Excellent
4516	Sediment Flowing into Coastal Wetlands	G	E	E	E	G	G	E	Excellent
7059	Wastewater Pollution	G	E	E	E	G	M	E	Excellent
8135	Contaminants Affecting Productivity of Bald Eagles	E	E	E	G	G	M	G	Excellent
9000	Acid Rain	G	E	E	E	E	M	E	Excellent
8	Salmon and Trout	G	G	E	M	G	F	G	Good
9	Walleye and Hexagenia	G	G	E	G	G	M	M	Good
18	Sea Lamprey	E	E	E	E	F	G	M	Good
68	Native Unionid Mussels	G	E	E	G	F	F	M	Good
72	Fish Entrainment	E	G	M	M	G	E	G	Good
93	Lake Trout and Scud (<i>Diaporeia hoyi</i>)	E	E	E	E	M	M	G	Good
101	Deformities, Erosion, Lesions and Tumors in Nearshore Fish	E	E	E	E	F	G	F	Good
104	Benthos Diversity and Abundance	G	E	E	E	F	F	G	Good
109	Phytoplankton Populations	E	G	M	E	F	G	F	Good
113	Contaminants in Recreational Fish	E	E	M	G	G	G	G	Good
114	Contaminants in Young-of-the-Year Spottail Shiners	G	E	M	E	G	E	G	Good
116	Zooplankton Populations	G	E	G	E	M	G	G	Good
117	Atmospheric Depositions of Toxic Chemicals	G	G	E	E	F	M	M	Good
118	Toxic Chemical Concentrations in Offshore Waters	E	E	E	E	F	E	G	Good
119	Concentration of Contaminants in Sediment Cores	E	E	E	E	F	M	G	Good
4083	Chemical Contaminants in Fish Tissue	G	E	M	E	M	F	G	Good
4088	Chemical Contaminant Intake from Air, Water, Soil and Food	G	M	E	E	F	F	M	Good
4175	Chemical and Microbial Drinking Water Quality	G	E	E	E	G	M	G	Good
4177	Chemical Contaminants in Human Tissue	G	G	E	E	F	F	M	Good
4178	Radionuclides	G	E	G	E	G	M	F	Good
4179	Geographic Patterns and Trends in Disease Incidence	G	E	M	G	G	M	G	Good
4501	Invertebrate Community Health	G	E	E	E	F	M	G	Good
4502	Fish Community Health	G	E	E	E	F	M	M	Good
4503	Deformities/Eroded Fins/Lesions/Tumors (DELT) in Coastal Wetland Fish	G	E	E	E	F	M	E	Good
4504	Amphibian Diversity and Abundance	G	E	E	G	G	F	G	Good
4506	Contaminants in Snapping Turtle Eggs	G	E	E	E	F	F	F	Good
4507	Wetland-Dependent Bird Diversity and Abundance	G	E	E	G	G	M	G	Good
4510	Wetland Area by Type	G	E	E	M	F	F	M	Good

ID #	Indicator Name	Validity	Understandability	Interpretability	Information Richness	Data Availability	Timeliness	Feasibility	Ranking
4513	Presence, Abundance & Expansion of Invasive Plants	E	E	E	G	F	E	M	Good
4519	Global Warming: Number of Extreme Storms	G	M	G	M	G	M	G	Good
4857	Global Warming: First Emergence of Water Lily Blossoms in Coastal Wetlands	G	E	E	M	M	M	F	Good
4858	Global Warming: Ice Duration on the Great Lakes	G	E	E	M	G	F	G	Good
4860	Nitrates and Total Phosphorus Into Coastal Wetlands	E	E	E	E	F	E	G	Good
4861	Water Level Fluctuations	G	E	E	M	E	G	G	Good
7000	Urban Density	E	G	M	E	F	M	F	Good
7012	Mass Transportation	G	G	E	G	F	F	F	Good
7043	Economic Prosperity	E	G	M	G	E	M	E	Good
7055	Habitat Adjacent to Coastal Wetlands	G	G	G	G	F	M	F	Good
7056	Water Consumption	G	E	M	G	G	F	E	Good
7057	Energy Consumption	E	E	M	E	G	M	E	Good
7060	Solid Waste Generation	G	E	G	E	G	M	F	Good
8114	Habitat Fragmentation	E	E	E	E	F	G	M	Good
8129	Area, Quality, and Protection of Special Lakeshore Communities	G	E	E	E	M	F	F	Good
8131	Extent of Hardened Shoreline	G	E	E	G	M	F	M	Good
8132	Nearshore Land Use Intensity	G	E	E	E	F	M	M	Good
8134	Nearshore Plant and Wildlife Problem Species	G	G	E	E	F	F	F	Good
8136	Extent and Quality of Nearshore Natural Land Cover	G	E	E	E	G	F	M	Good
8139	Community/Species Plans	M	E	G	E	E	F	G	Good
8141	Shoreline Managed Under Integrated Management Plans	M	E	E	G	F	F	G	Good
8142	Streamflow	G	E	E	E	F	G	G	Good
8146	Artificial Coastal Structures	E	E	E	G	F	M	M	Good
8147	Contaminants Affecting the American Otter	E	E	E	G	M	M	M	Good
8149	Protected Nearshore Areas	G	G	E	E	M	F	M	Good
8150	Breeding Bird Diversity and Abundance	G	E	E	G	M	G	M	Good
8161	Threatened Species	G	E	E	E	G	E	M	Good
9001	Atmospheric Visibility: Prevention of Significant Deterioration	G	G	M	E	G	M	G	Good
6	Aquatic Habitat	G	M	M	E	F	M	F	Moderate
120	Contaminant Exchanges Between Media: Air to Water, and Water to Sediment	G	F	G	E	F	M	M	Moderate
4511	Gain in Restored Wetland Area by Type	M	E	G	M	F	F	M	Moderate
7002	Land Conversion	G	G	M	M	F	M	M	Moderate
7006	Brownfield Redevelopment	G	G	M	F	M	F	M	Moderate
7028	Sustainable Agricultural Practices	G	E	M	G	F	F	G	Moderate
7042	Aesthetics	G	M	M	G	F	M	F	Moderate
7053	Green Planning Process	M	E	M	G	F	F	M	Moderate

ID #	Indicator Name	Validity	Understandability	Interpretability	Information Richness	Data Availability	Timeliness	Feasibility	Ranking
8137	Nearshore Species Diversity and Stability	M	E	G	E	P	F	F	Moderate
8140	Financial Resources Allocated to Great Lakes Programs	M	G	E	M	F	F	M	Moderate